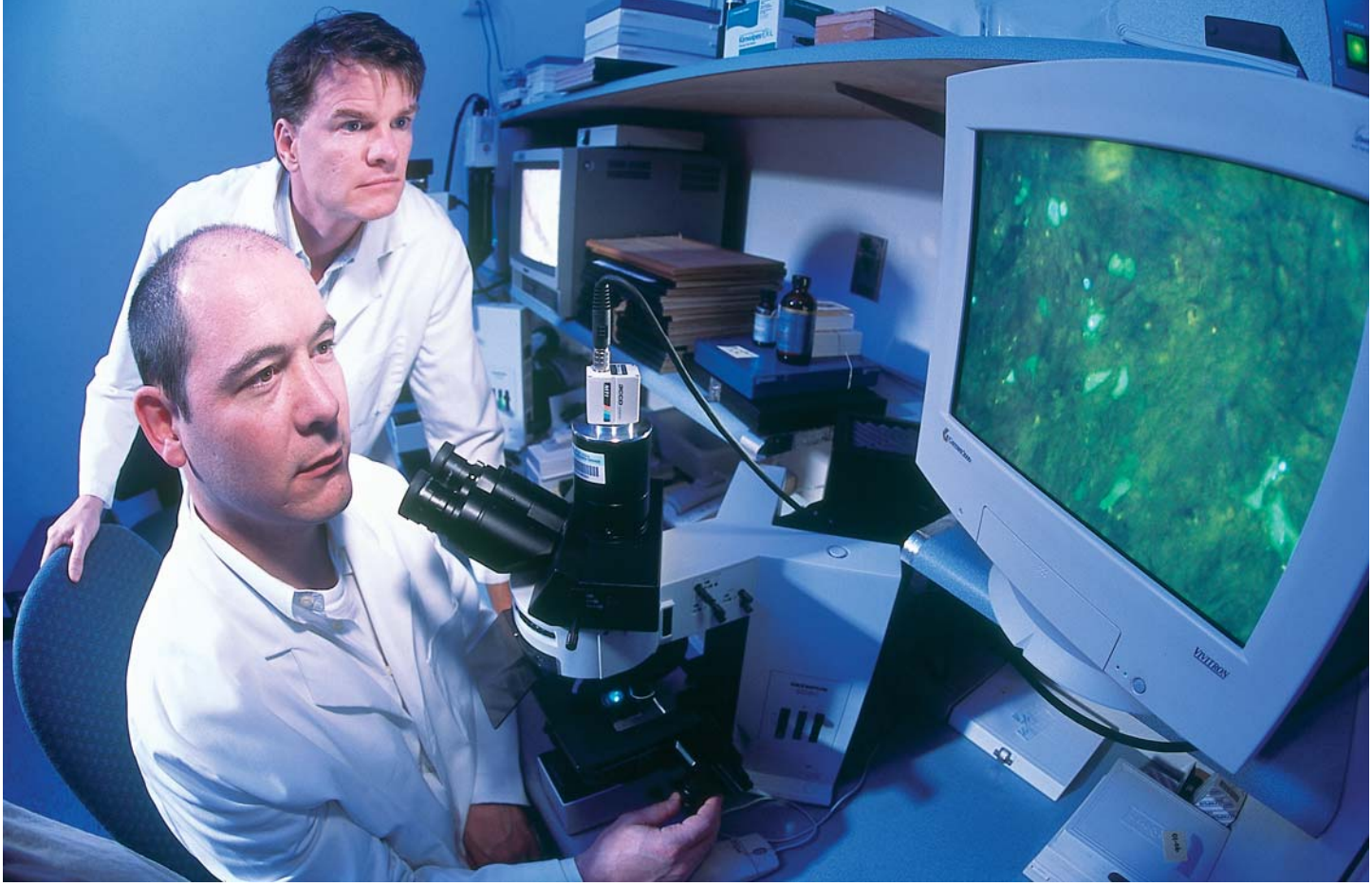


STEPHEN AUSMUS (K10699-1)

Microbiologist Darrell Kapczynski (foreground) and immunologist Terry Tumpey use ultraviolet microscopy to examine cell monolayers for production of a green fluorescent protein that indicates binding of the vaccine to host cells.

An END for Exotic Newcastle Disease Virus?

The last thing poultry producers want their flocks hit with is exotic Newcastle disease (END), a contagious and fatal viral disease affecting most species of birds. Almost all unvaccinated chickens die within days of being infected with the virus.

The END outbreak, diagnosed in late 2002, left its mark on California, then spread to Nevada and Arizona before it was contained. About 3.5 million commercial and backyard poultry, including chickens, geese, peacocks, pigeons, and turkeys, were euthanized to stop the disease from marching into other states. More than $104.5 million has been spent by a state-federal task force to try to contain and eradicate END.

To prevent a devastating outbreak in commercial flocks in the United States, scientists are researching diagnostic tools as well as preventive vaccines. Agricultural Research Service microbiologist Darrell Kapczynski is working on a new type of vaccine to combat the virus.

The vaccines currently available for Newcastle disease virus are made with either an attenuated (weakened) live virus or a killed virus. Either type stimulates an immune response in the bird, which protects it from future exposure to the virus. While these vaccines are effective, some production losses have been attributed to the live ones, and the inactivated ones are more expensive to administer. To overcome those problems, Kapcyznski and his colleagues at the Southeast Poultry Research Laboratory in Athens, Georgia, developed what's known as a nonreplicating virosome vaccine.

"Essentially, the virus is taken apart, the replicating genetic material is removed, and the virus is put back together," explains Kapczynski. "This vaccine induces protective immunity but does not allow the virus to replicate—copy itself—or pass from bird to bird."

The virosome vaccine is composed of liposomes, water-insoluble spheres encased in lipid layers. The liposomes contain certain viral protein antigens but not the virus replication machinery. The antigens are able to bring about a protective immune response in the animal.

In one study, day-old chicks were divided into three groups: a control group, which received saline solution; a group that received live-virus vaccine; and a group that received the virosome vaccine. Two weeks later, birds were challenged with a lethal dose of the virus. All birds were monitored daily for clinical signs of disease and mortality. Birds in the control group did not survive the challenge, but birds that received either the live-virus or virosome vaccine were 100 percent protected from the END virus.

While the cost of virosome technology is currently prohibitive, there are several potential advantages. First, since the vaccine has no replicating genetic material, the virus can't mutate or transfer from bird to bird. Second, since

STEPHEN AUSMUS (K10702-1)

Technician Tracy Smith-Faulkner examines chicken embryos for the presence of virus in samples collected from vaccinated birds. The absence of virus in embryos indicates the birds were protected against infection and disease.

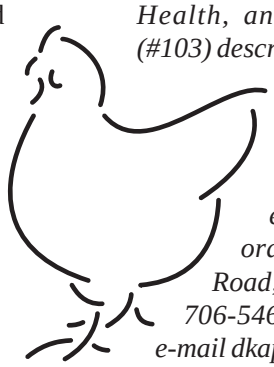
STEPHEN AUSMUS (K10700-1)

A virosome vaccine against Newcastle disease is administered to a baby chick intranasally by microbiologist Darrell Kapczynski.

the virosomes are able to attach and fuse with host cells, as would the live virus, a strong immunity is induced. Third, it is possible to differentiate between vaccinated and virus-infected birds. Birds vaccinated with an attenuated live or a killed virus will produce antibodies against all the virus's proteins. This leaves producers unsure of whether the flock is infected by field (nonvaccine) virus. But virosome vaccines induce antibodies against only two END proteins—the fusion and hemagglutinin-neuraminidase proteins. This allows producers to identify vaccinated flocks by testing for antibodies against these proteins. Birds exposed to field virus can be identified by testing them for antibodies to viral proteins not included in the virosome. Also, production losses attributed to using a live-virus vaccine are not an issue when using virosomes.

Under certain circumstances, vaccinating a flock does not guarantee complete protection. Kapczynski and colleague Daniel (Jack) King studied commercial birds that were vaccinated with a commercial vaccine against Newcastle disease and then exposed to the END virus. Seventy-five percent of the flock died. "It took longer for the birds to get sick and die," says Kapczynski. "It seems that even though the birds had been vaccinated, they were severely weakened by the virus challenge." In the field, weakened birds are much more susceptible to infection by secondary pathogens.

Even though END has not spread widely throughout the United States, it is still necessary to find ways to protect commercial and backyard poultry flocks and indigenous birds. The recent isolation of END virus from a backyard flock in Texas underscores the need for continued surveillance.



The next step for Kapczynski and his colleagues is to determine whether the virosome vaccine can protect a typical commercial flock, which is exposed to various production and environmental stresses, such as other illnesses and temperature fluctuations. "It's a long way from the lab to the field. The vaccine has to be protective in the field, which is the gold standard of effectiveness," says Kapczynski.

Successful completion of this work may offer poultry producers a new option for ending END.—By **Sharon Durham,** ARS.

This research is part of Animal Health, an ARS National Program (#103) described on the World Wide Web at www.nps.ars.usda.gov.

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